Madden-Julian Oscillation:
Recent Evolution, Current Status and Predictions

Update prepared by the Climate Prediction Center
NWS / NCEP / CPC
10 March 2025

Overview

- Following a period of incoherence, an active MJO pattern has re-emerged over the global tropics, with the enhanced convective phase currently centered over Africa.

- A low frequency disruption of the trade wind regime over the eastern Pacific has resulted in rapid warming of SSTs east of 150W. Enhanced trades and below-normal SSTs persist near and west of the Date Line.

- Dynamical model MJO index forecasts show an active intraseasonal signal crossing the Indian Ocean during Week-1 and early Week-2, with ensemble members diverging over the Maritime Continent in late Week-2.

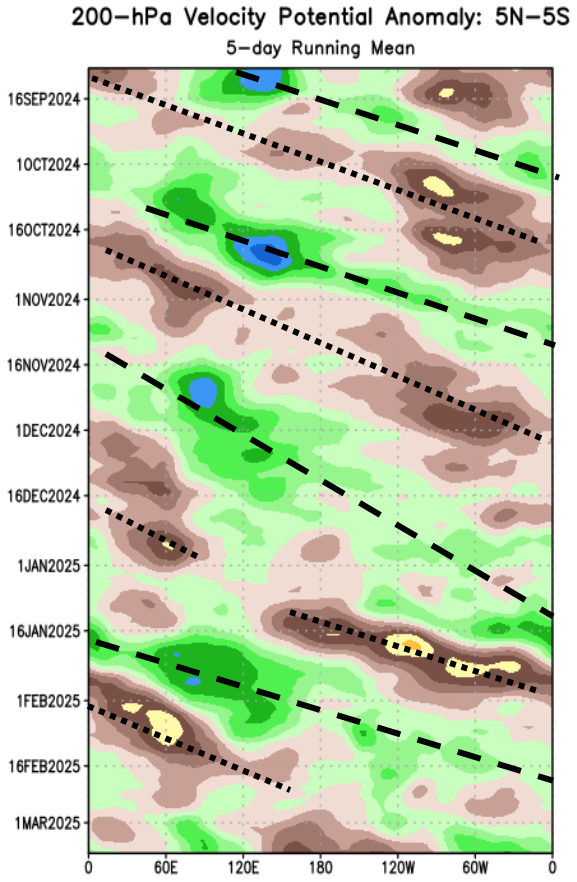
- Should the MJO manage to emerge over the West Pacific during Week 3, low-level westerly wind anomalies over a warmer than normal West Pacific Warm Pool could result in a downwelling oceanic Kelvin wave that would further erode the La Niña.

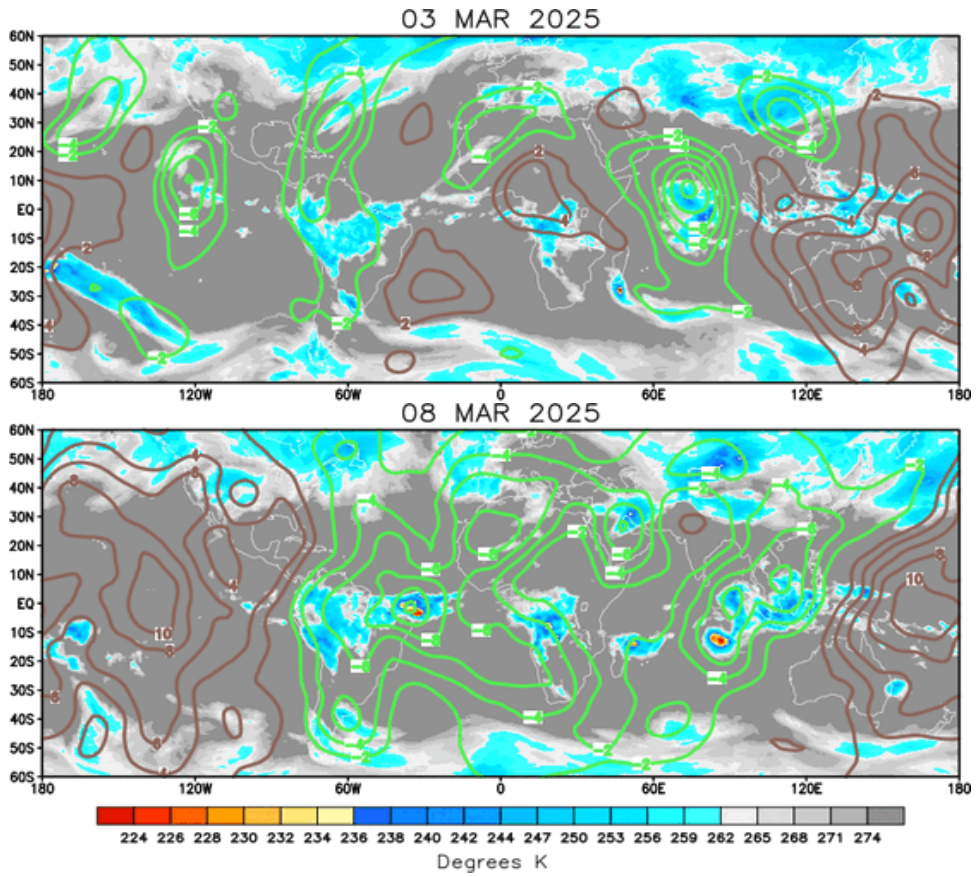
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation)

Brown shades: Anomalous convergence (unfavorable for precipitation)

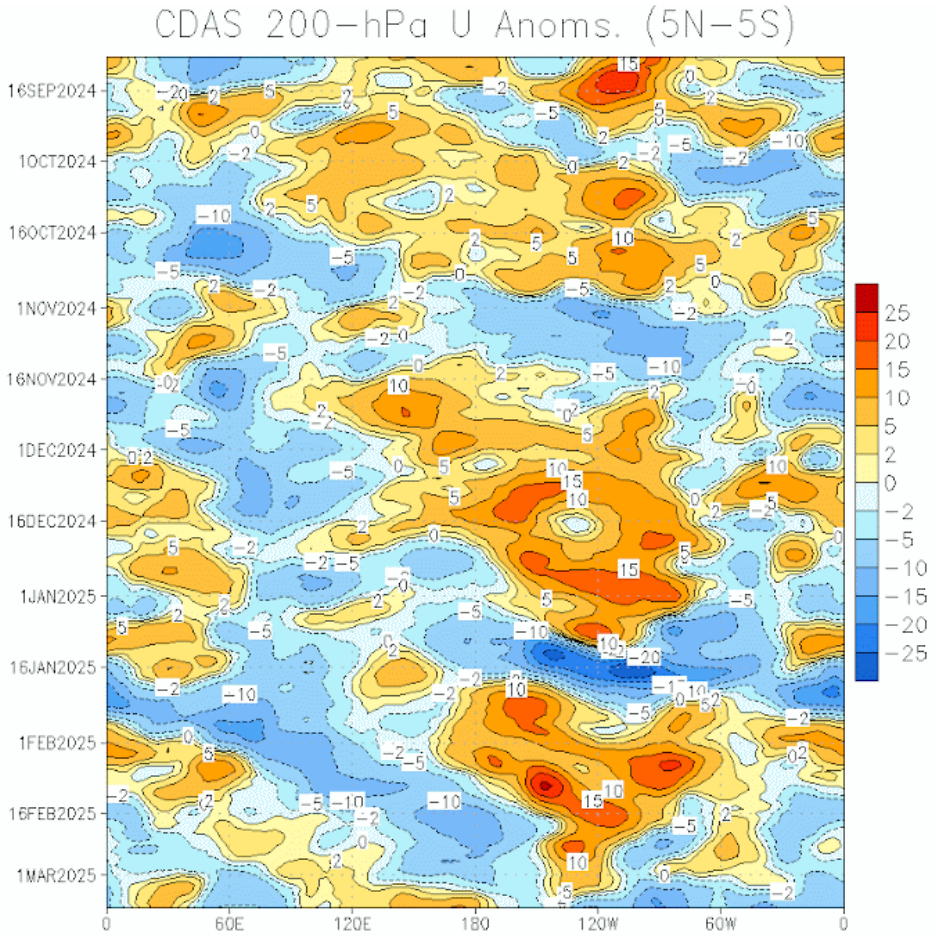


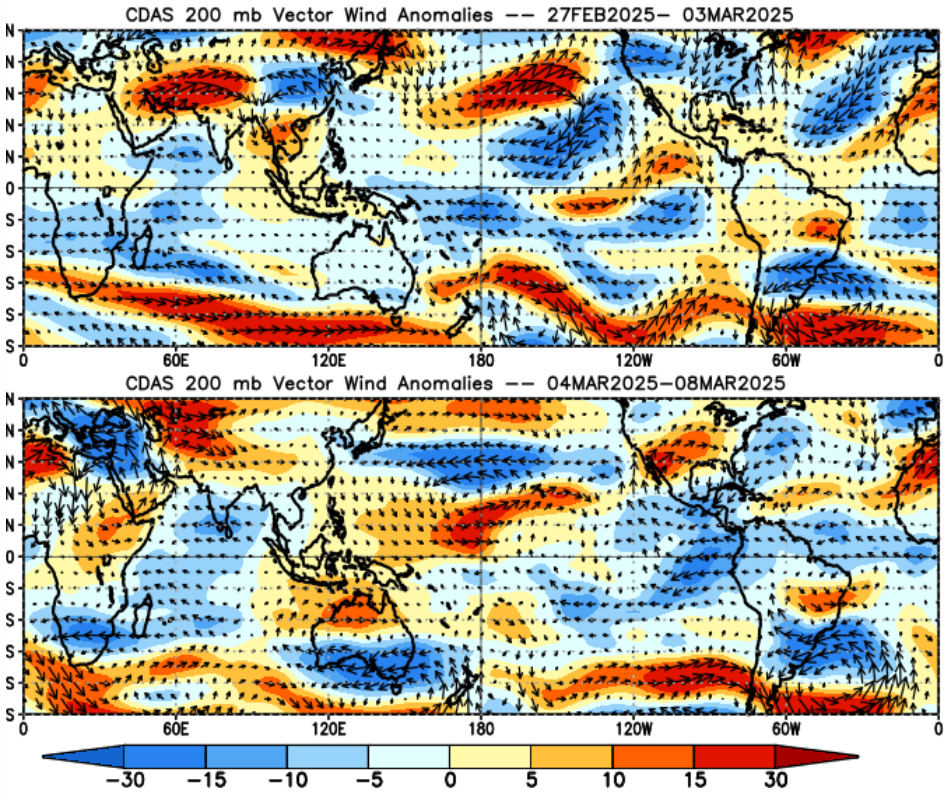


- Following a period of coherent activity during January and early February, the MJO weakened during late February as other modes interfered with the signal. This resulted in a smaller scale chaotic appearance in the spatial field of upper-level VP anomalies.
- A more coherent signal began to re-emerge during early March, with the enhanced divergent (suppressed) signal centered over Africa (the Pacific basin).

200-hPa Wind Anomalies

Shading denotes the zonal wind anomaly. Blue shades: Anomalous easterlies. Red shades: Anomalous westerlies.

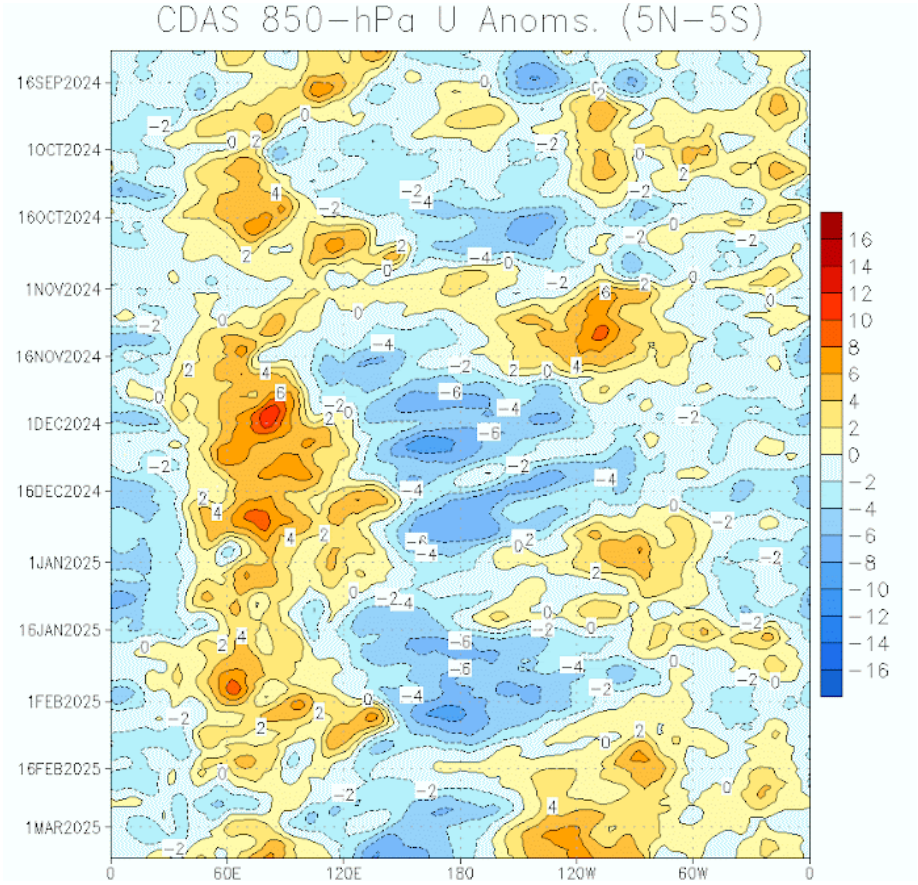


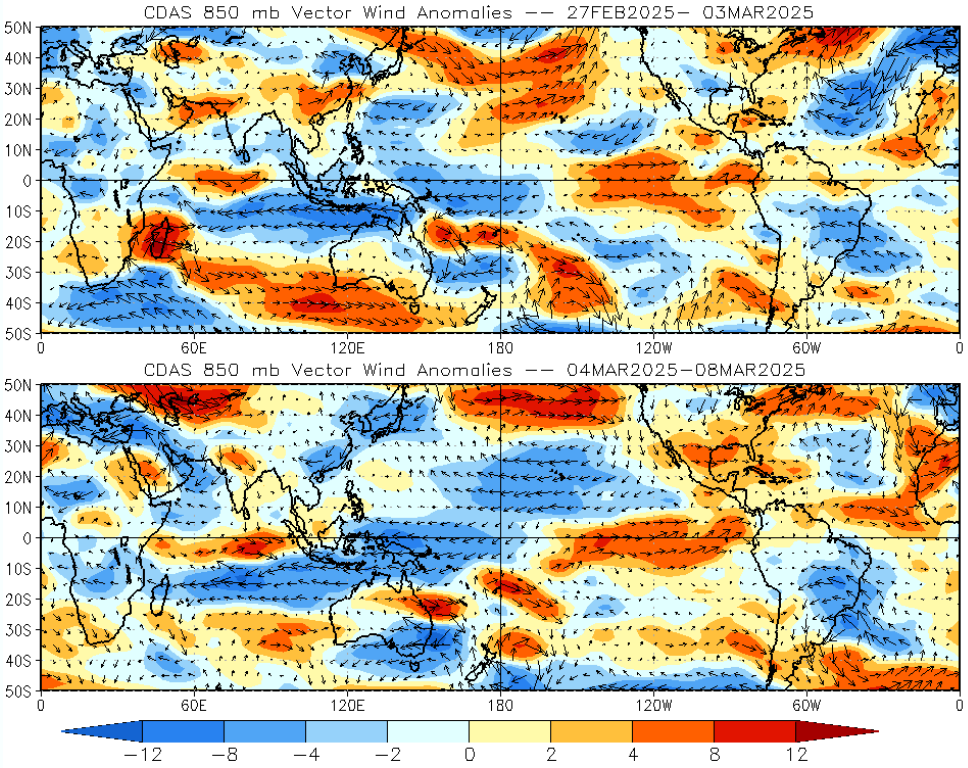


- Sustained eastward propagation of a couplet of westerly and easterly anomalies during January and February is reflective of an active MJO pattern.
- Rossby wave activity over the East Pacific and Western Hemisphere interfered with the MJO signal during late February.

850-hPa Wind Anomalies

Shading denotes the zonal wind anomaly. Blue shades: Anomalous easterlies. Red shades: Anomalous westerlies.

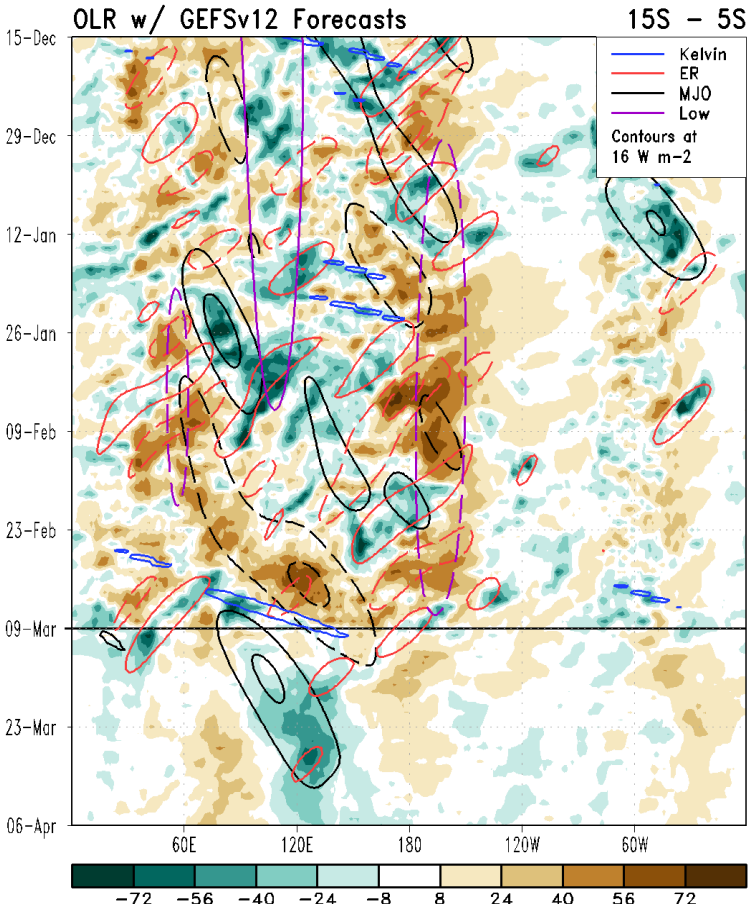


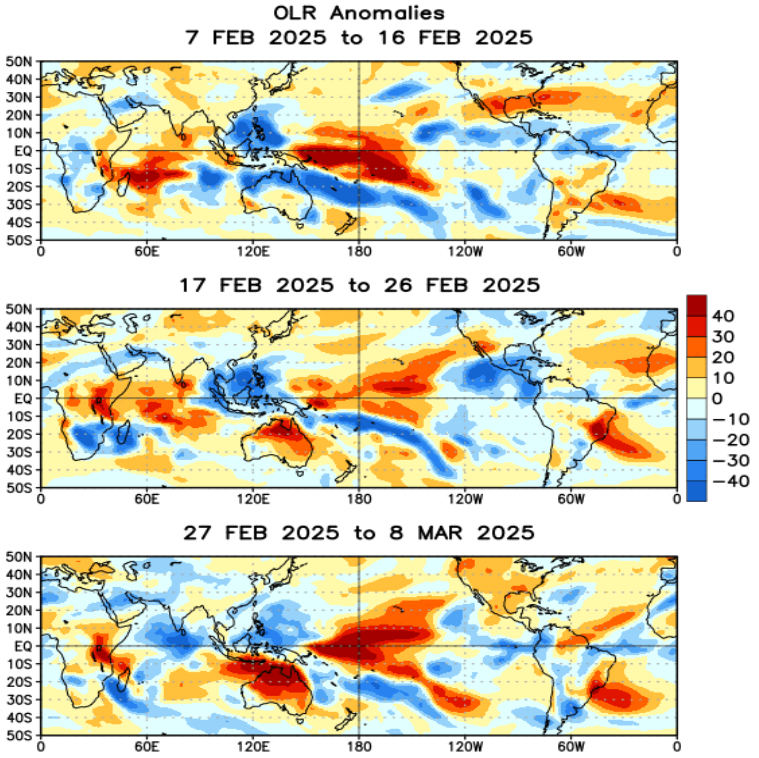


- Robust MJO activity briefly weakened the La Niña associated enhanced trade wind regime over the central Pacific during early and mid-February.
- The MJO signal became disrupted by late February due to equatorial Rossby wave interference. A strong Kelvin wave propagated ahead of the remnant MJO envelope across the Indian Ocean basin.
- A low frequency disruption of the trade winds has become established over the eastern Pacific, which has overturned the negative SSTs. The enhanced trade regime persists near and west of the Date Line.

Outgoing Longwave Radiation (OLR) Anomalies

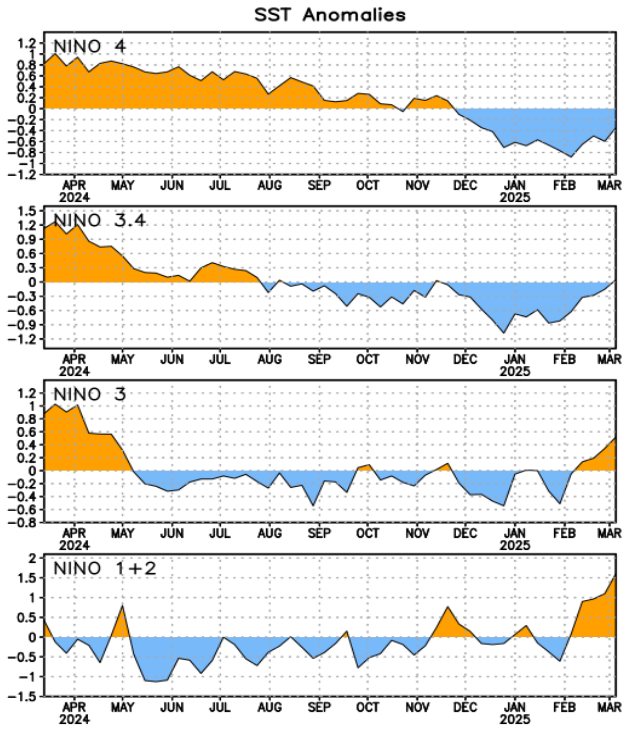
Green shades: Anomalous convection (wetness)
Brown shades: Anomalous subsidence (dryness)

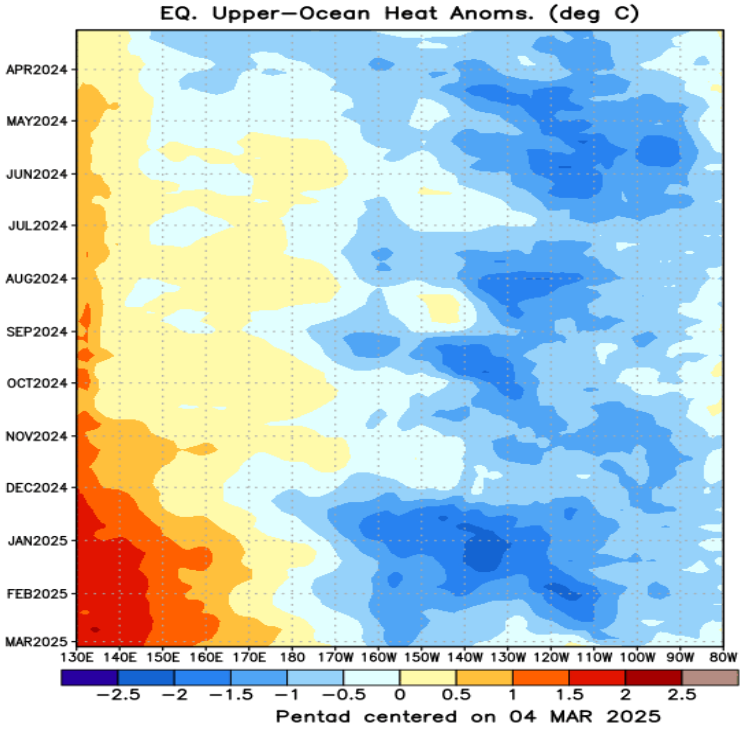




- While the enhanced convective envelope associated with the MJO became disrupted during late February, the suppressed phase crossed the Maritime Continent and was associated with drier conditions across Australia.
- Convection increased over the Indian Ocean during early March, and GEFS forecasts indicate a return to an active MJO pattern during the next several weeks.

SSTs and Weekly Heat Content Evolution in the Equatorial Pacific

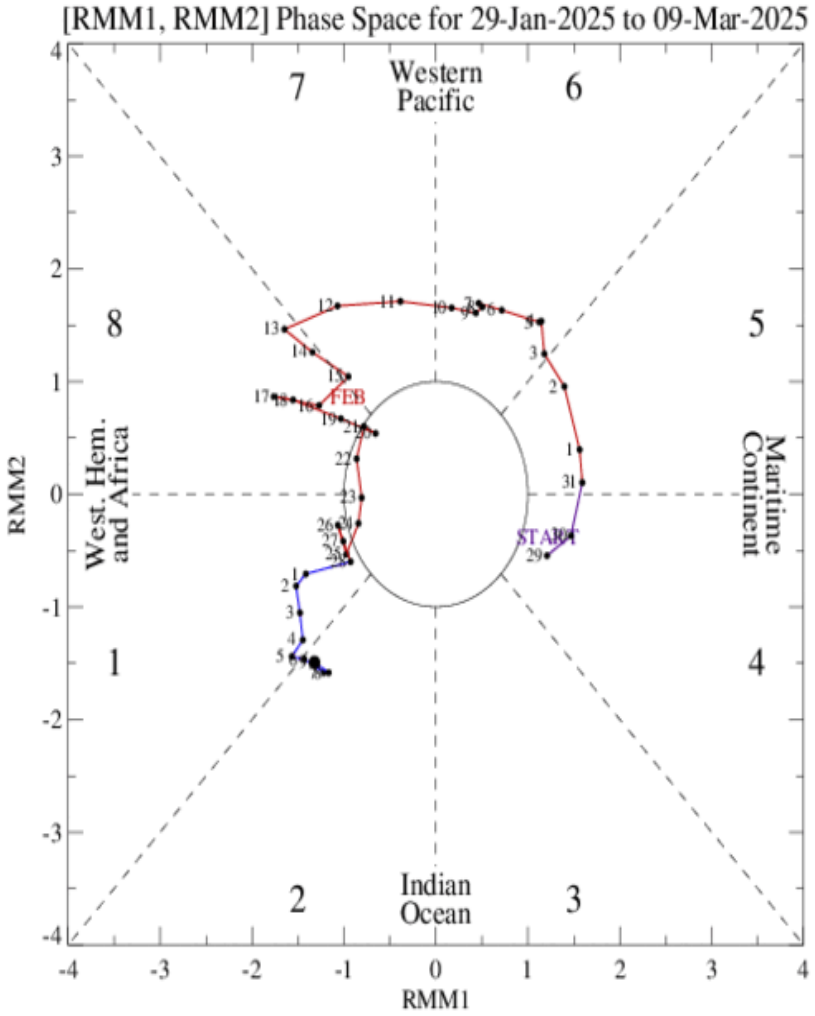




- Negative SST anomalies decreased to near zero in the Nino 3.4 region, and has trended positive in the easternmost basins.
- The West Pacific Warm Pool is much warmer than average, with a gradual eastern expansion of heat content eastward to the Date Line.
- Given the extent of warm ocean water availability over the West Pacific, the current La Niña conditions are vulnerable to any downwelling oceanic Kelvin wave events that could initiate due to MJO activity.

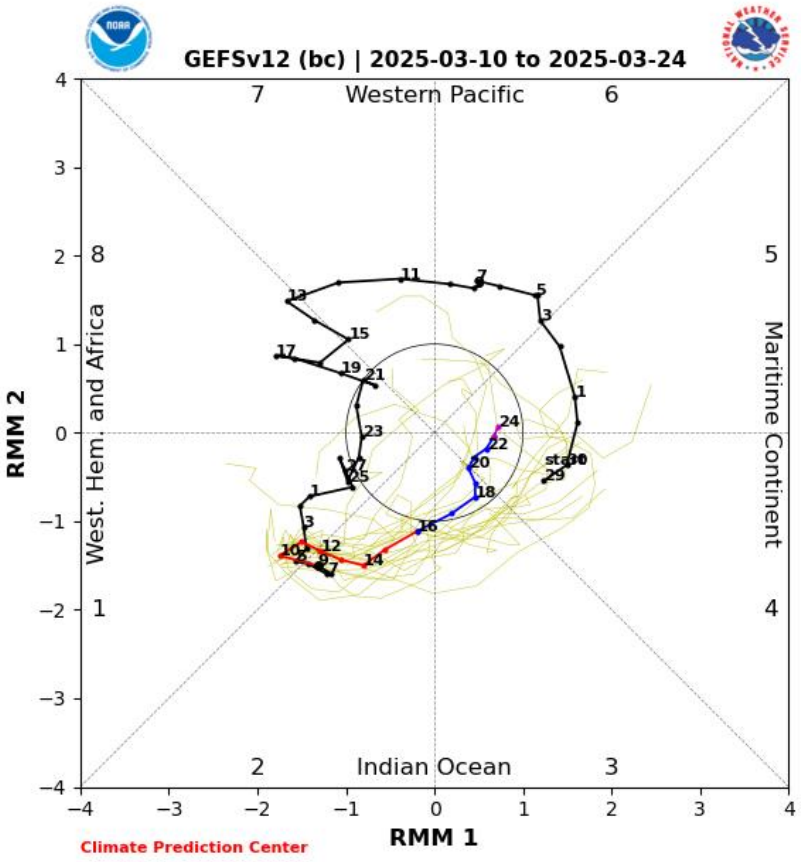
MJO Index: Recent Evolution

- Robust MJO activity was depicted on the RMM based MJO index during late January and the first half of February.
- During the second half of February, Rossby wave activity interfered with the MJO, causing the signal to stall and eventually move within the unit circle.
- The signal re-amplified and eastward propagation was re-established towards the end of February and early March, with the enhanced convective phase now crossing Africa and entering the Indian Ocean basin.

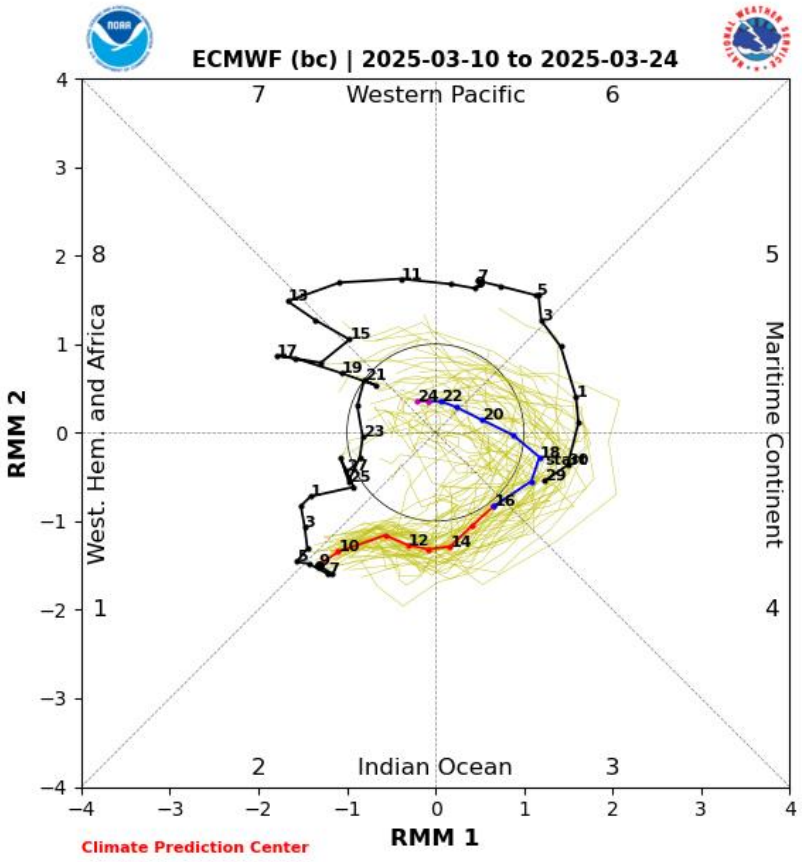


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast

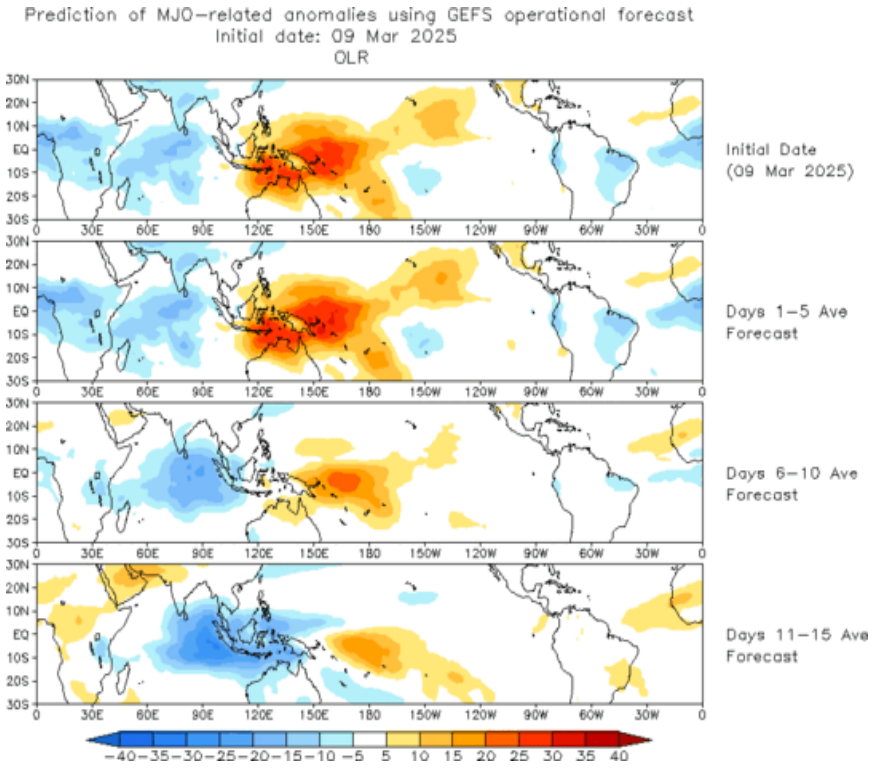


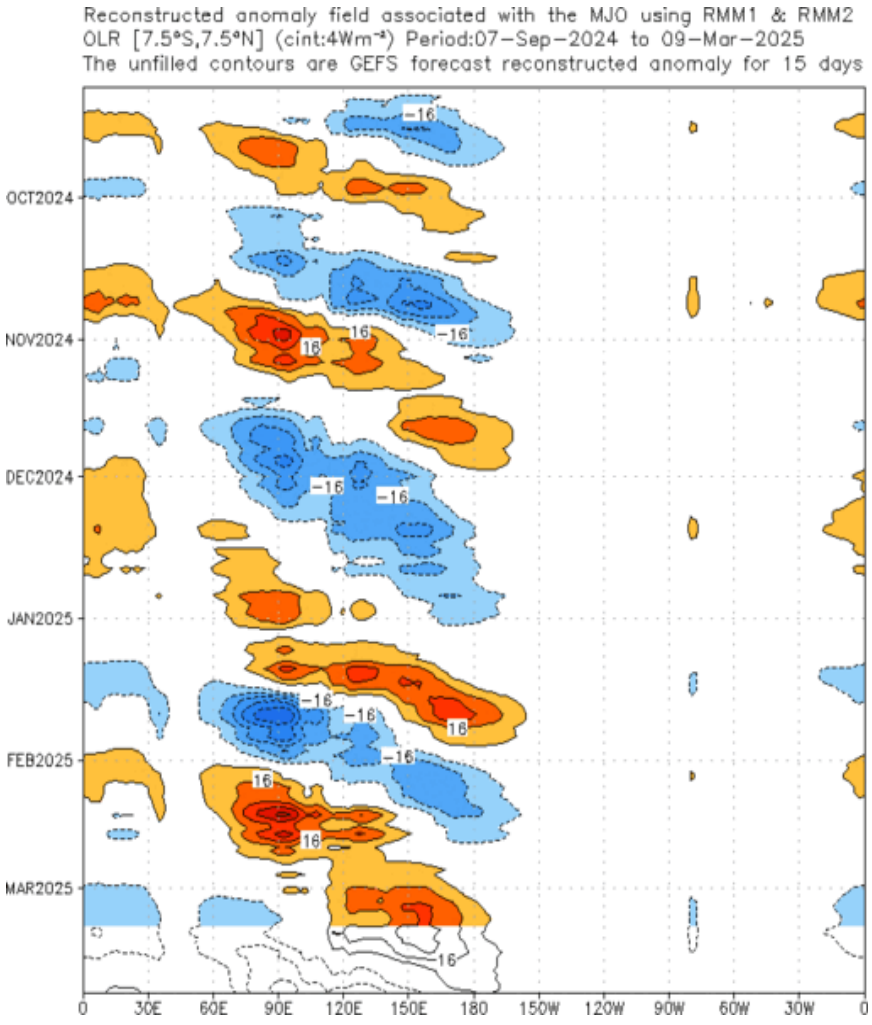
ECMWF Forecast

- Both the GEFS and ECMWF favor an active MJO signal crossing the Indian Ocean during mid-March.
- Uncertainty increases during Week-2 as the MJO signal crosses the Maritime Continent.

MJO: GEFS Forecast Evolution

Figures below show MJO associated OLR anomalies only (reconstructed from RMM1 and RMM2) and do not include contributions from other modes (*i.e.*, ENSO, monsoons, etc.)

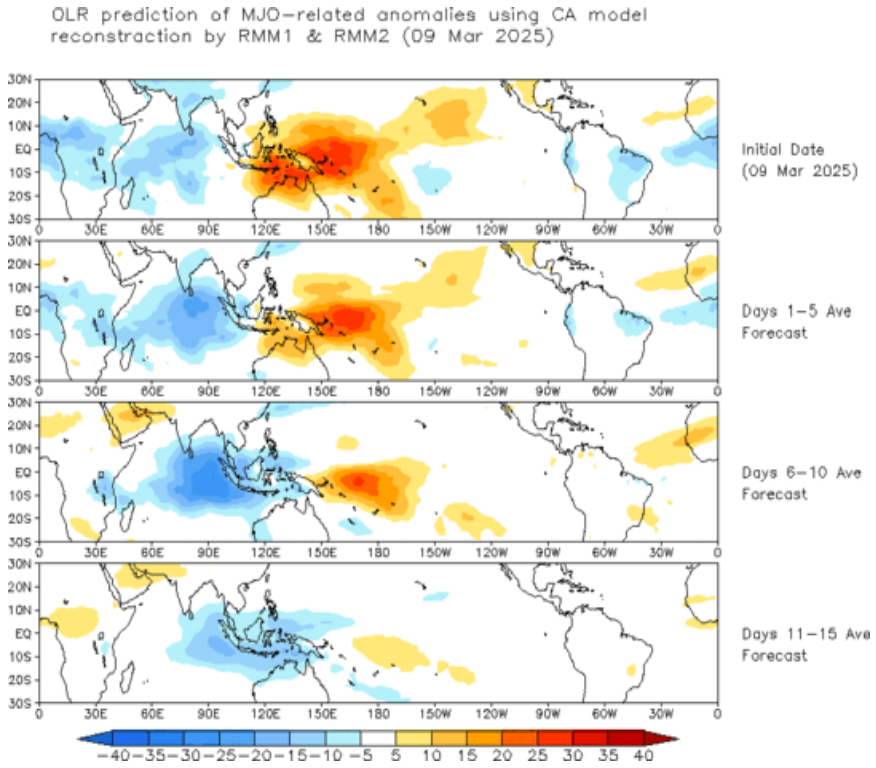


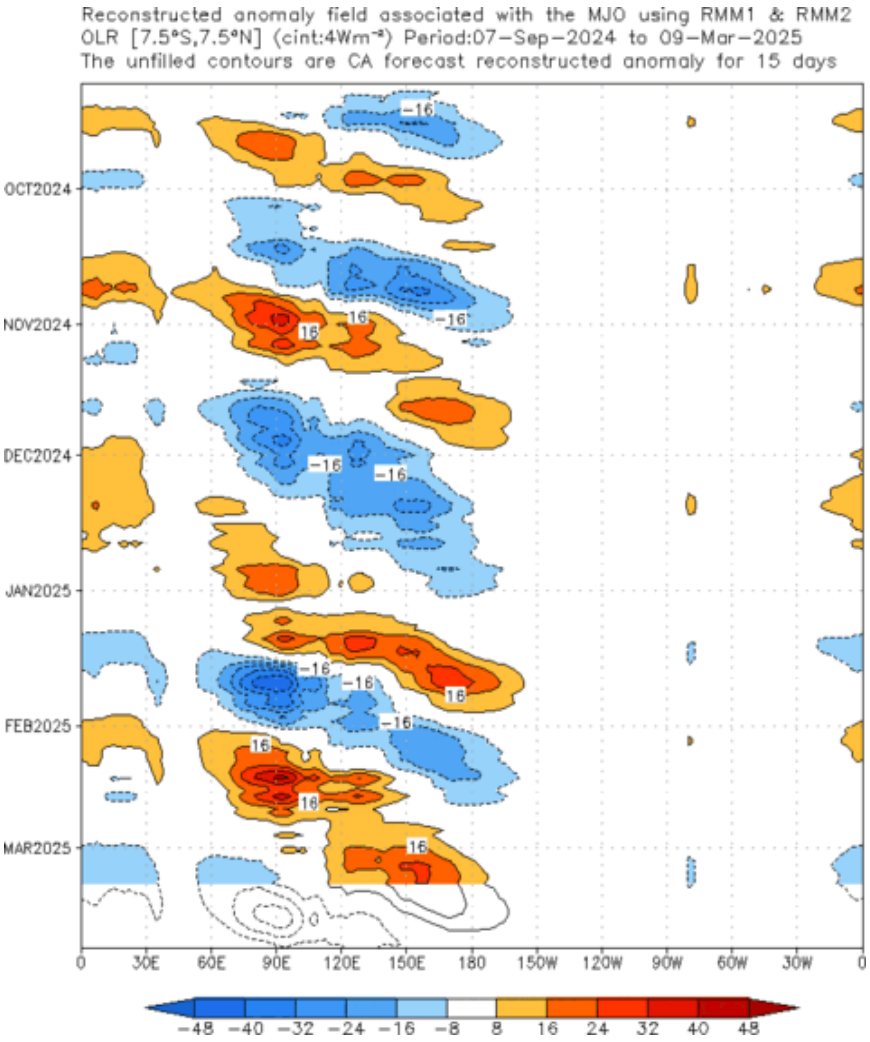


- The GEFS OLR forecast based on the RMM index forecast depicts activity consistent with robust MJO evolution, with the enhanced convective phase propagating across the Indian Ocean and Maritime Continent over the next two weeks.

MJO: Constructed Analog Forecast Evolution

Figures below show MJO associated OLR anomalies only (reconstructed from RMM1 and RMM2) and do not include contributions from other modes (*i.e.*, ENSO, monsoons, etc.)

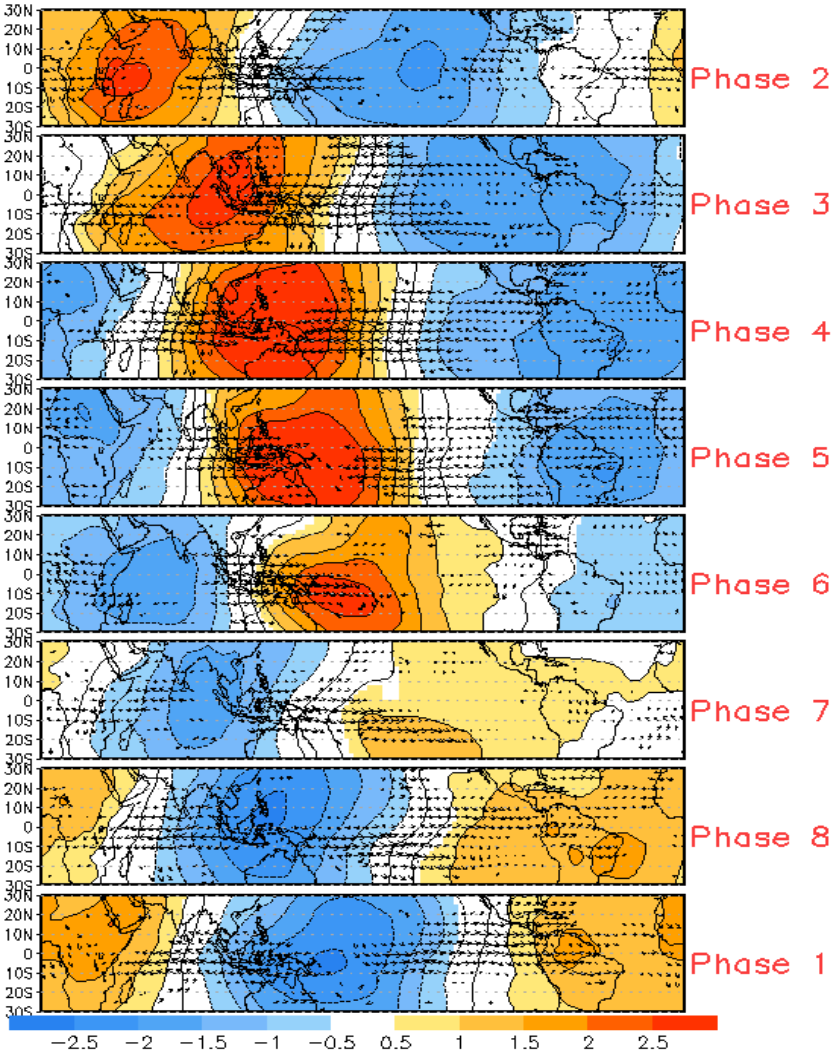




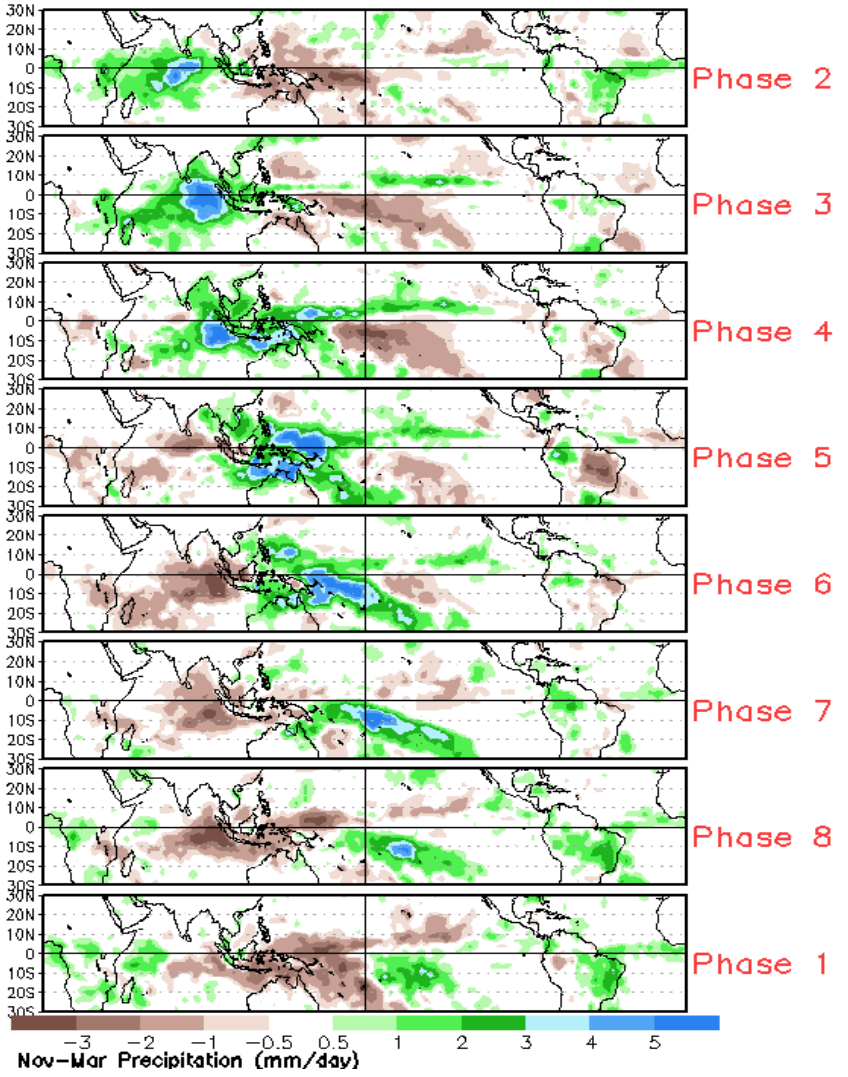
- The constructed analog forecast is very similar to the GEFS.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



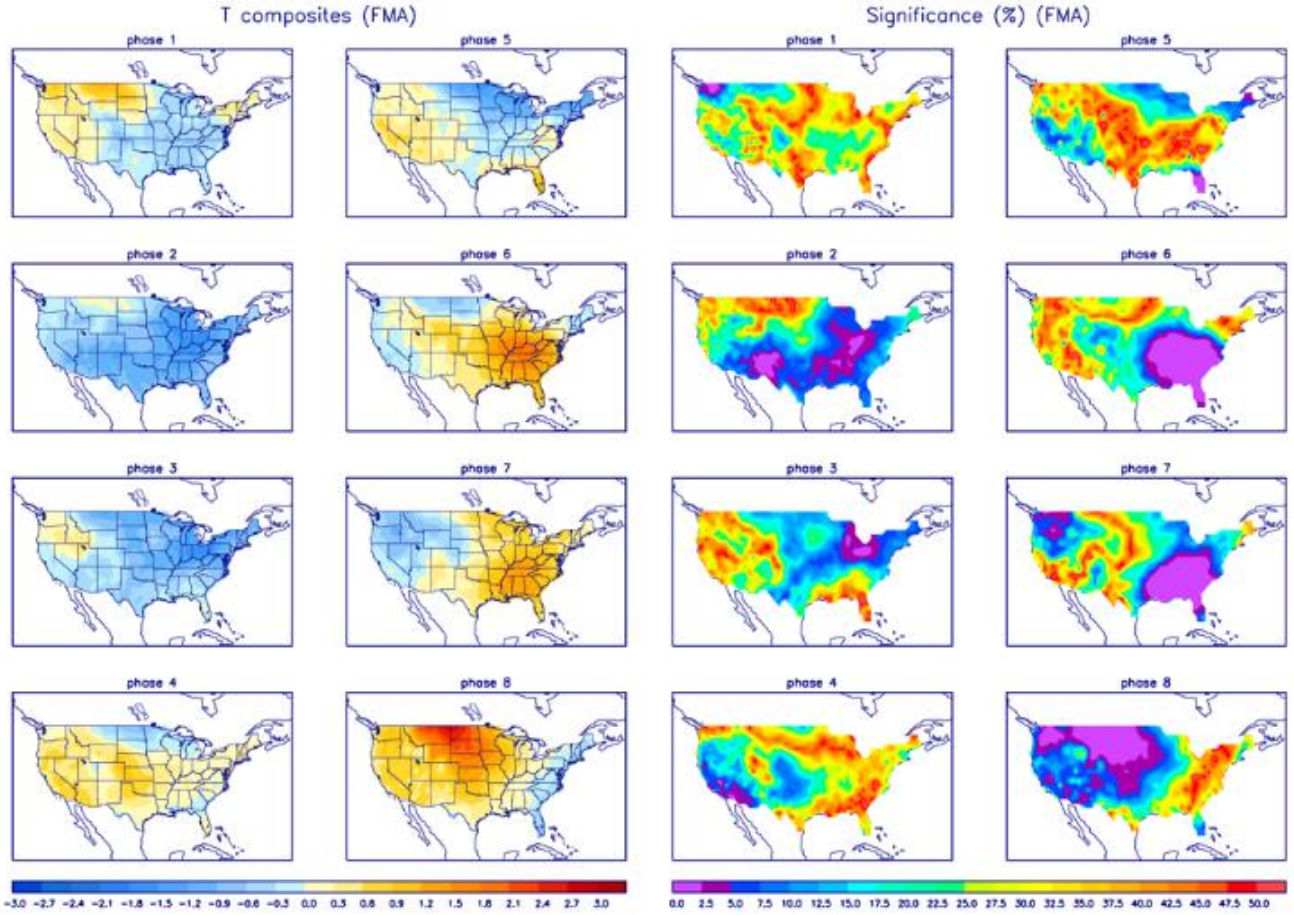
Precipitation Anomalies



MJO: CONUS Composite Maps by RMM Phase - Temperature

Left hand side plots show temperature anomalies by MJO phase for MJO events that have occurred over the three month period in the historical record. Blue (red) shades show negative (positive) anomalies respectively.

Right hand side plots show a measure of significance for the left hand side anomalies. Purple shades indicate areas in which the anomalies are significant at the 95% or better confidence level.

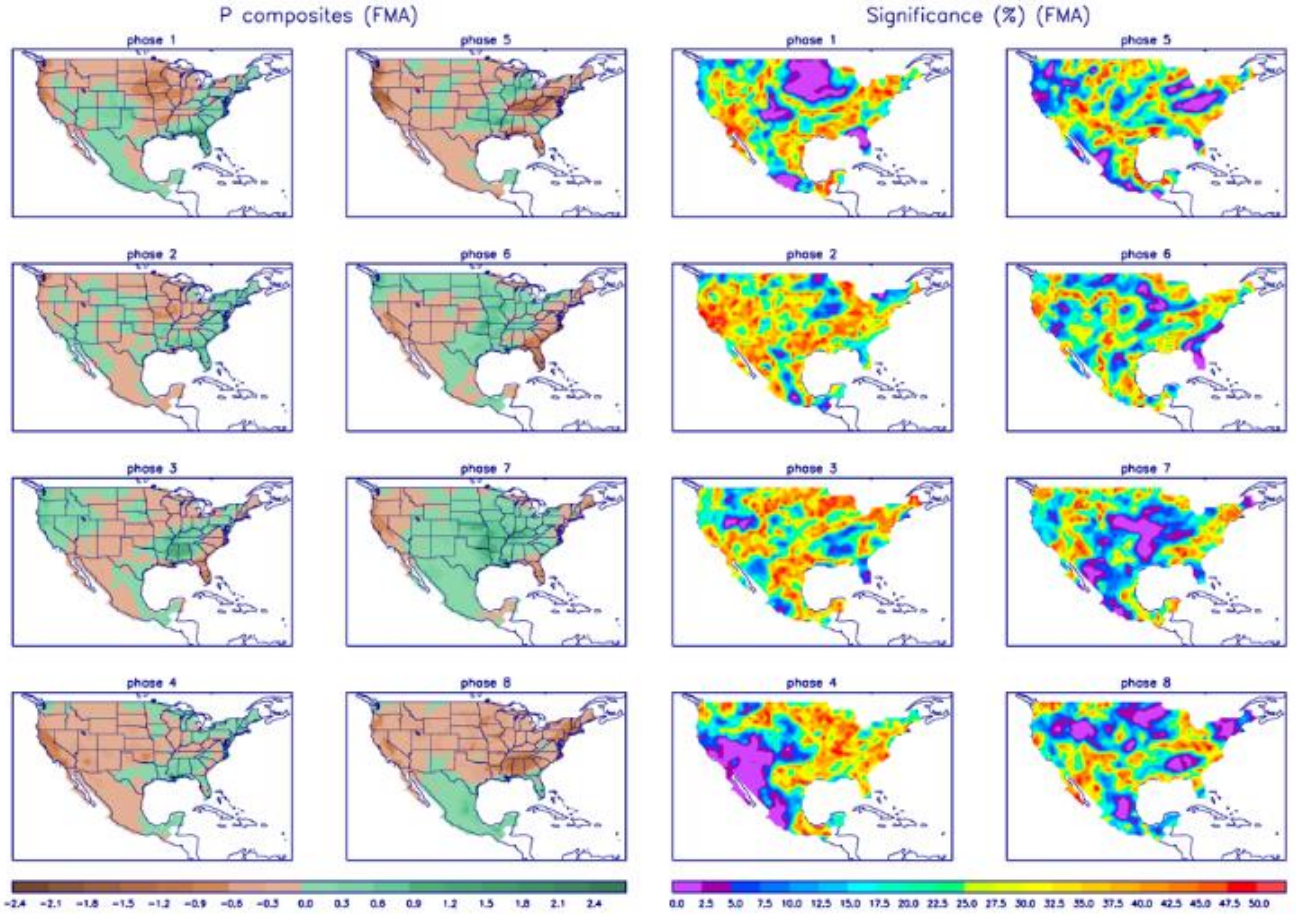


More information: http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/mjo.shtml

MJO: CONUS Composite Maps by RMM Phase - Precipitation

Left hand side plots show precipitation anomalies by MJO phase for MJO events that have occurred over the three month period in the historical record. Brown (green) shades show negative (positive) anomalies respectively.

Right hand side plots show a measure of significance for the left hand side anomalies. Purple shades indicate areas in which the anomalies are significant at the 95% or better confidence level.



More information: http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/mjo.shtml